REMARKS

The Office Action dated October 4, 2006 has been received and carefully reviewed. The preceding amendments and the following remarks form a full and complete response thereto. Claims 16 and 17 have been amended. No new matter has been added. Accordingly, claims 2-10 and 12-19 are pending in this application and are submitted for consideration.

Claims 2-3, 10 and 12-19 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 6,051,955 to Saeki et al. ("Saeki"). Remaining claims 4-9 were rejected under 35 U.S.C. § 103(a) as being unpatentable over the combination of Saeki with U.S. Patent No. 5,990,664 to Rahman. Applicants respectfully traverse the rejections and submit that claims 2-10 and 12-19 recite subject matter not disclosed or suggested by the cited prior art.

Claim 16, upon which claims 2-10, 14-15 and 19 depend, recites a charge control circuit for a battery pack, which includes rechargeable battery elements (9) arranged in respective parallel branches (3) of a parallel circuit of battery voltage sources, state monitoring means (11, 13, 17) for monitoring the battery state of battery elements (9), and switches (15) that can be controlled by the state monitoring means, for interrupting the current flow or releasing the current flow. Each parallel branch (3) has associated state monitoring means (11, 13, 17), and a respective switch (15) is provided in each parallel branch (3). The respective switch (15) can be controlled on the basis of the battery state, which is monitored by the state monitoring means (11, 13, 17), of the

relevant parallel branch (3), in order to selectively block or release only this relevant parallel branch (3) for the current flow.

According to Fig. 3 of Saeki, the battery protection circuit of Saeki consists of rechargeable battery elements E_{11} ...E_{32} arranged in respective parallel branches E_1 and E_2 of a parallel circuit of battery voltage sources. According to Saeki, the circuit consists of a voltage monitoring circuit 2 as a state monitoring means, by way of which the voltages of the individual battery cells E_{11} ... E_{32} may be monitored. When the voltage of at least one battery cell E_{11}...E_{32} falls outside a predetermined range, the voltage monitoring circuit 2 triggers the switches 5, 7, or 6, 8 for interrupting the current, such that the complete battery unit is switched off and cannot be discharged or charged for the time being. Thus, the battery unit is always disconnected when the voltage of at least one battery element (battery cell) falls outside the target voltage range. Hence, in the battery pack Saeki that has a large number of battery elements (cells), the result of an early breakdown of the battery is substantially burdensome.

In great contrast to Saeki, the claimed invention overcomes such a situation by improving a charge control circuit or discharge control circuit of the above-mentioned kind such that battery packs of larger capacity having a plurality of parallel branches and series connected battery elements in the parallel branches may be reliably and durably operated as electric power source. On point, claim 16 defines that each parallel branch has associated state monitoring means and that in each parallel branch a respective switch is provided which can be controlled in accordance with the battery

state monitored by the state monitoring means of the respective parallel branch, in order to selectively interrupt or release only one respective parallel branch.

Contrary to the subject matter of Saeki, according to the claimed invention, the complete battery pack is not disconnected because one single battery cell (battery element) assumes a state causing the state monitoring means to output a switching signal.

The charge control circuit according to the claimed invention may certainly get into a situation, where initially only in one parallel branch of battery elements the state monitoring means detects a change in the battery state and then activates their associate switch to interrupt the charge current flow. This, however, only causes an electrical disconnection of this parallel branch and not the disconnection of the whole battery pack or the interruption of the charging as a whole. The remaining parallel branches may be charged until the respective state monitoring means, in a selective manner, also activate the voltage interrupt switches. Thus, according to the charge control circuit of the claimed invention, for each individual parallel branch the state "parallel branch optimally charged" may be detected in accordance with criteria further explained in detail in the present application, as for example the transgression of a maximum value (threshold) of the temperature, or a maximum value of the charge current in a charge time interval, or a maximum value of the temperature change per time unit etc., in order to separate the respective parallel branches electrically from the battery charger, when they have reached the state of an o[optimal charge. As already mentioned, this may happen at different times in the different parallel branches. The

parallel branches finally being optimally charged, the charge control circuit of the invention separates the battery pack electrically from the battery charger. Thus, the charge control circuit enables a balanced and efficient charging of the battery pack. Such an advantageous charging behavior would not be possible with a battery protection circuit according to Saeki, as the state monitor means 2 – when detecting a respective change of state in any of the battery cells E_{11} ... E_{32} – issue their voltage interruption signal to the switches 5, 6, 7, 8 and hence separate the complete battery pack electrically from a device at the outer terminals 9, 10.

Thus, in view of the foregoing, Applicants submit that Saeki fails to disclose or suggest each and every feature of claim 16, upon which claims 2-10, 14-15 and 19 depend. Rahman does not describe the battery protection circuits and instead, is directed to control of the terminal output voltage, and Rahman fails to cure the described deficiencies of Saeki. Accordingly, Applicants submit that the rejections to claims 2-10, 14-16 and 19 are improper and request that the rejections of claims 2-10, 14-16 and 19 be withdrawn.

Claim 17, upon which claims 12-13 and 18 depend, recites a discharge control circuit for a battery pack having rechargeable battery elements (9), which are arranged in respective parallel branches of a parallel circuit of battery voltage sources (3). The discharge control circuit includes state monitoring means (11, 13, 17) and switches (15), which can be controlled by the state monitoring means, for interrupting the current flow or releasing the current flow. Each parallel branch includes, in series with the battery voltage source (3) having one or more battery elements (9) represented by it, a

respective controllable switch (15) having an integrated diode (23), or one which is connected in parallel therewith, which is conductive in the discharge current flow direction. The state monitoring means (13) are set so as to switch the controllable switch (15) of a respective parallel branch from a high-resistance state to a low-resistance state when a discharge current, having a minimum current level, flows through the diode (23) associated with the switch (15), such that only the respective parallel branch is selectively blocked or left open for the flow of charge.

As a result of the claimed configuration, a discharge control circuit is provided by which battery packs having a larger capacity and a plurality of battery blocks coupled in parallel may be operated reliably and durably as electric energy sources. Each parallel branch, in series with the battery voltage source comprising one or more battery elements which is represented by it, has a respective controllable switch having an integral diode, or one which is connected in parallel, which is conductive in the discharge current flow direction. State monitoring means is provided and adapted to switch the respective controllable switch from a high-resistance state to a low-resistance state, when a discharge current having a minimum current level flows through the diode.

By simple means, the discharge control circuit according to claim 17 can ensure that, in cases where parallel branches having different charge levels, the more weakly charged parallel branches are not charged by the more heavily charged parallel branches due to the occurrence of undesired internal charge currents.

As explained in detail on pages 18 and 19 of the Specification of the present application, the diodes and the state monitoring means serve for automatically assuring

that in case of parallel branches (blocks) having different charge levels, first only the most heavily charged battery block is incorporated in the discharging process with connected load. The diode of the more heavily charged parallel branch becomes conductive in forward direction faster than the diodes in said other parallel branches. The state monitoring means can then actuate the switch of the most heavily charged parallel branch to a low-resistance state so that the voltage of the parallel branch is applied to the load. As a result, the diodes of the further parallel branches initially can still be poled in locking direction, until the most heavily charged battery block (parallel branch), which has been incorporated first into the discharging process, is discharged to such an extent that its charge state essentially coincides with the charge state of a further battery block in the parallel circuit. Only then, the further battery block causes a discharge current flow via its diode, which is detected by the state monitoring means and causes the associated switch in said parallel branch to be switched to a low-resistance state. In accordance with this principle, the parallel branches could be incorporated into the discharging process one after the other, without more weakly charged parallel branches being charged by more heavily charged parallel branches.

Saeki fails to disclose or suggest such principles. In each of its parallel branches, the circuit according to Fig. 3 of Saeki provides a switch 6 or 8 having a diode connected in parallel in discharge current flow direction (without reference number). However, the state monitoring means 2 fail to detect the start of a current flow through the individual diodes, but only detect the voltage at the individual battery cells $E_{11} \ldots E_{32}$. With respect to Saeki, it is possible that a more heavily charged parallel

branch charges a more weakly charged parallel branch, which, however, is avoided due to the discharge control circuit according to claim 17 of the present application.

Thus, in view of the foregoing, Applicants submit that Saeki fails to disclose or suggest each and every feature of claim 17, upon which claims 12-13 and 18 depend. Rahman does not describe the battery protection circuits and instead, is directed to control of the terminal output voltage, and Rahman fails to cure the described deficiencies of Saeki. Accordingly, Applicants submit that the rejections to claims 12-13 and 17-18 are improper and request that the rejections of claims 12-13 and 17-18 be withdrawn.

In view of the above, all objections and rejections have been sufficiently addressed. Applicants submit that the application is now in condition for allowance and requests that claims 2-10 and 12-19 be allowed and this application passed to issue.

In the event that this paper is not timely filed, the Applicants respectfully petition for an appropriate extension of time. Any fees for such an extension together with any additional fees may be charged to Counsel's Deposit Account No. 02-2135.

If for any reason the Examiner determines that the application is not now in condition for allowance, it is respectfully requested that the Examiner contact, by telephone, the Applicants' undersigned attorney at the indicated telephone number to arrange for an interview to expedite the disposition of this application.

Respectfully submitted,

3-5-07
Date

Brian A. Tollefson
Attorney for Applicants
Registration No. 46,338
ROTHWELL, FIGG, ERNST & MANBECK, P.C.
Suite 800, 1425 K Street, N.W.
Washington, D.C. 20005
Telephone: (202) 783-6040

1384636